Uddeholm
AM Corrax®

UDDEHOLM

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Uddeholm AM Corrax is a stainless steel made for Additive Manufacturing with a unique set of properties making it the ultimate choice for tools where superior corrosion resistance combined with high hardness is needed. These properties makes it perfectly suitable for tools for plastic molds including demanding applications such as moulds for medical parts, corrosive plastics i.e PVC and parts made of rubber material.

AM Corrax offers high polishability in terms of surface finish and ease to process resulting in a high gloss surface suitable for challenging tooling applications.

The corrosion resistance is also beneficial when implementing complicated conformal cooling designs due to minimized risk for clogging of cooling channels, oxide layers reducing the cooling efficiency or corrosion initiated cracks.

The favorable chemical composition makes AM Corrax easy to process in additive manufacturing processes to get excellent printing results and excellent material properties.

Classified according to EU Directive 1999/45/EC
For further information see our "Material Safety Data Sheets".

Edition 1, 05.2017

SS-EN ISO 9001
SS-EN ISO 14001

GENERAL

Uddeholm AM Corrax offers several advantages compared to most AM tool steels:

- Flexible hardness, 36-50HRC, achieved by an aging treatment in the temperature range 425-600°C (790-1110°F)
- Good dimensional stability during the aging treatment
- Excellent polishability
- No hard "white" layer after EDM
- Excellent corrosion resistance
- Easy to process in laser powder-bed as well as laser metal deposition AM equipment

APPLICATIONS

- Injection moulds for
  - corrosive plastics
  - rubber
  - medical and food industry
- Extrusion dies
- Plastic processing
  - Screws
- Engineering parts

CHEMICAL COMPOSITION

Typical analysis %	C	Si	Mn	Cr	Ni	Mo	Al
	0.03	0.3	0.3	12.0	9.2	1.4	1.6

O <250 ppm

PARTICLE SIZE AND SHAPE DISTRIBUTION

D10	D50	D90
25	38	53

*≤10 µm ~0.7% *≥65 µm ~3%

Sphericity	0.94
Aspect Ratio	0.90

PROPERTIES

PHYSICAL DATA

Density of solid corrax conventionally processed and aged to ~46 HRC at 20 °C 7 700 kg/m³

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density kg/m³ lbs/in³	7 700 0.28	– –	– –
Modulus of elasticity N/mm² psi	200 000 29 x 10^6	190 000 28 x 10^6	170 000 25 x 10^6
Coefficient of thermal expansion per°C from 20°C per°F from 68°F	– –	11.7 x 10^{-6} 6.5 x 10^{-6}	12.3 x 10^{-6} 6.8 x 10^{-6}
Thermal conductivity W/m °C Btu in/ft² h °F	– –	18 125	21 146

MECHANICAL DATA

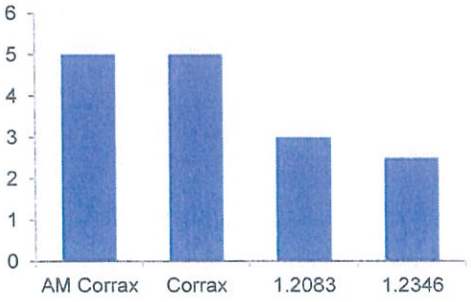
	As build 34 HRC	Solution treated 34 HRC	Aged to 40HRC	Aged to 46 HRC	Aged to 50 HRC
Yield strength Rp0.2 MPa	760	700	1000	1400	1600
Tensile strength Rm MPa	1150	1100	1200	1500	1700
Elongation A5 %	16	15	16	11	10
Compressive strength MPa	900	900	1300	1600	1800

The data was acquired from samples processed to >99.5 % density. Measured at room temperature.

CORROSION RESISTANCE

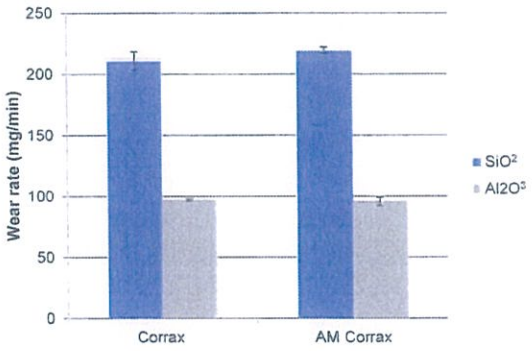
Uddeholm AM Corrax has a very good corrosion resistance, fully matching the conventionally manufactured Corrax and better than the corrosion resistant standard grades used for plastic moulding.

Uddeholm AM Corrax will withstand attacks from most corrosive plastics and diluted acids. A mould insert made of Uddeholm AM Corrax will also have good resistance to humid working and storage conditions. Uddeholm AM Corrax also shows better resistance to stress corrosion cracking than standard hardenable corrosion resistant steel grades.



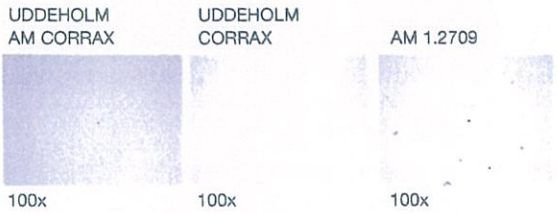
WEAR RESISTANCE

Due to high hardness and fine microstructure Uddeholm AM Corrax has an excellent wear resistance towards most media.



POLISHING

Uddeholm AM Corrax offers extremely high polishabilty that results in excellent surface finish and a high gloss polished surface. When processed correctly Uddeholm AM Corrax fully matches conventionally produced tool steels with its low amount of porosity and inclusions giving it perfect surfaces for high demanding tooling applications.



AM PROCESSING

Uddeholm AM Corrax can be easily and efficiently processed in most powder-bed laser additive manufacturing equipment.
Achieving optimum material performance could require customization of process parameters for each printer.

Some examples of process parameters are shown below and for further information please contact your local Uddeholm office.

	SLM 280	Trumpf 1000	EOS M290
Layer thickness	30µm	20µm	30µm
Laser power	200W	155W	170W
Scan speed	720mm/s	814mm/s	1250mm/s
Hatch distance	0,12mm	0,07mm	0,10mm
Hatch mode	Stripes	Checker-board	Stripes
Build plate temperature	No heating required	No heating required	No heating required

POST PROCESSING

SOLUTION TREATMENT

In the "as-printed" condition AM corrax material can contain up to 20 % retained austenite. The retained austenite content can be reduced to acceptable limits ~4% after solution treatment.
Solution treatment should be performed at 850 °C, holding time 30 minutes and then cool in air.

AGING

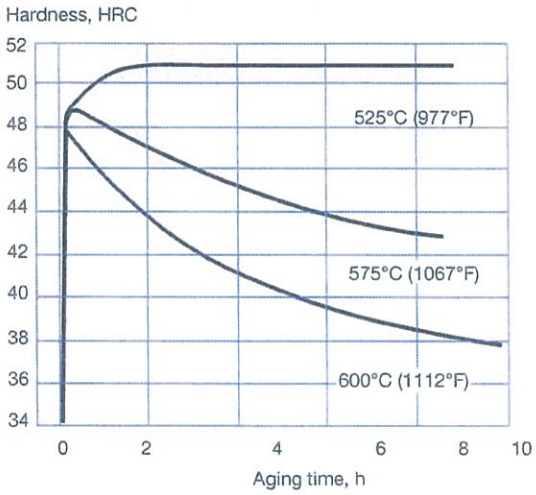
Suitable aging parameters can be obtained from the figure below. Aging time means the time at the ageing temperature after the tool is fully heated through.

When the aging time is reached, cool the tool in air to room temperature. Aging at high

temperature gives a better toughness compared with ageing to the same hardness at a lower temperature.

Uddeholm AM Corrax can also be used in as-printed condition but higher hardness is obtained by aging.

Aging temperature/time	Hardness
525°C/4 h (977°F/4 h)	49-52 HRC
575°C/4 h (1067°F/4 h)	44-47 HRC
600°C/4h (1112°F/4h)	40-43 HRC



STRESS RELIEVING

Stress relieving cannot be performed as for other steel grades since an increase in temperature results in a higher hardness because of ageing effect.
AM Corrax does not need stress relieving after the AM process.

DIMENSIONAL CHANGE

Aging results in a small and uniform decrease in volume. The following shrinkage can be expected during aging.

Aging	Dimensional change %		
	Longitudinal direction	Transversal direction	Short transversal direction
525°C/4 h (977°F/4 h) ~50 HRC	–0.07	–0.07	–0.07
575°C/4 h (1067°F/4 h) ~46 HRC	–0.09	–0.09	–0.09
600°C/4h (1112°F/4h) ~40 HRC	–0.14	–0.14	–0.14

EDM

Uddeholm Corrax can be EDM'd in the same way as ordinary tool steels. The "white layer" will, however, not be as hard and is therefore more easily removed.

GRINDING

A general grinding wheel recommendation is given below. More information can be found in the Uddeholm publication "Grinding of Tool Steel".

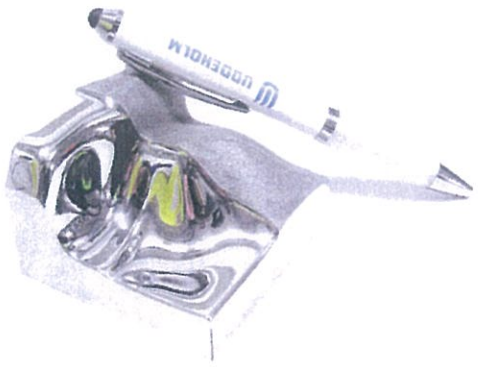
Type of grinding	Delivery condition and aged condition
Face grinding straight wheel	A 46 GV
Face grinding segments	A 36 FV
Cylindrical grinding	A 60 JV
Internal grinding	A 60 IV
Profile grinding	A 120 JV

When good surface finish is required a SiC-wheel could be an alternative.

POLISHING

Uddeholm AM Corrax exhibits excellent polishability behavior in both as-built and heat-treated conditions. A slightly different and more demanding technique is needed when polishing corrosion-resistant tool steels as compared to conventional ones.

Usually more steps are required between fine grinding and polishing stages. On the contrary, for AM Corrax after rough and fine grinding it is possible to achieve high quality gloss surface finish with only three steps between lapping and polishing stages. For more detailed recommendations please refer to the Uddeholm polishing of mould steel data sheet.



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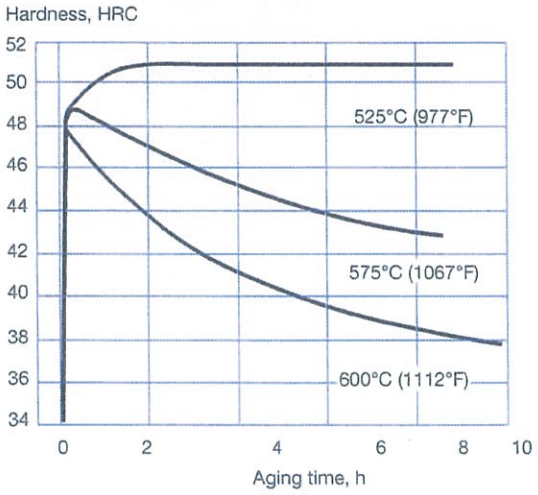

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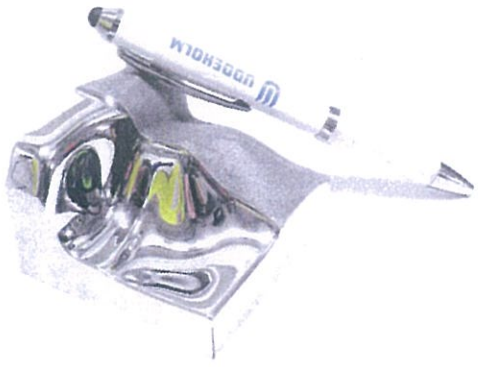


PHOTO-ETCHING

Uddeholm Corrax has a very good corrosion resistance and a special process is thus required for chemical photo-etching. Fine patterns with shallow depths <0.04 mm (0.002") are readily achievable.

FURTHER INFORMATION

Please, contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steels.

OTHER PRODUCTS AND SERVICES

BUILD PLATES

To get optimal quality of your powder bed builds using Uddeholm Corrax plates are the best choice. Pre-machined build plates are available in dimensions of 300x300x50mm.

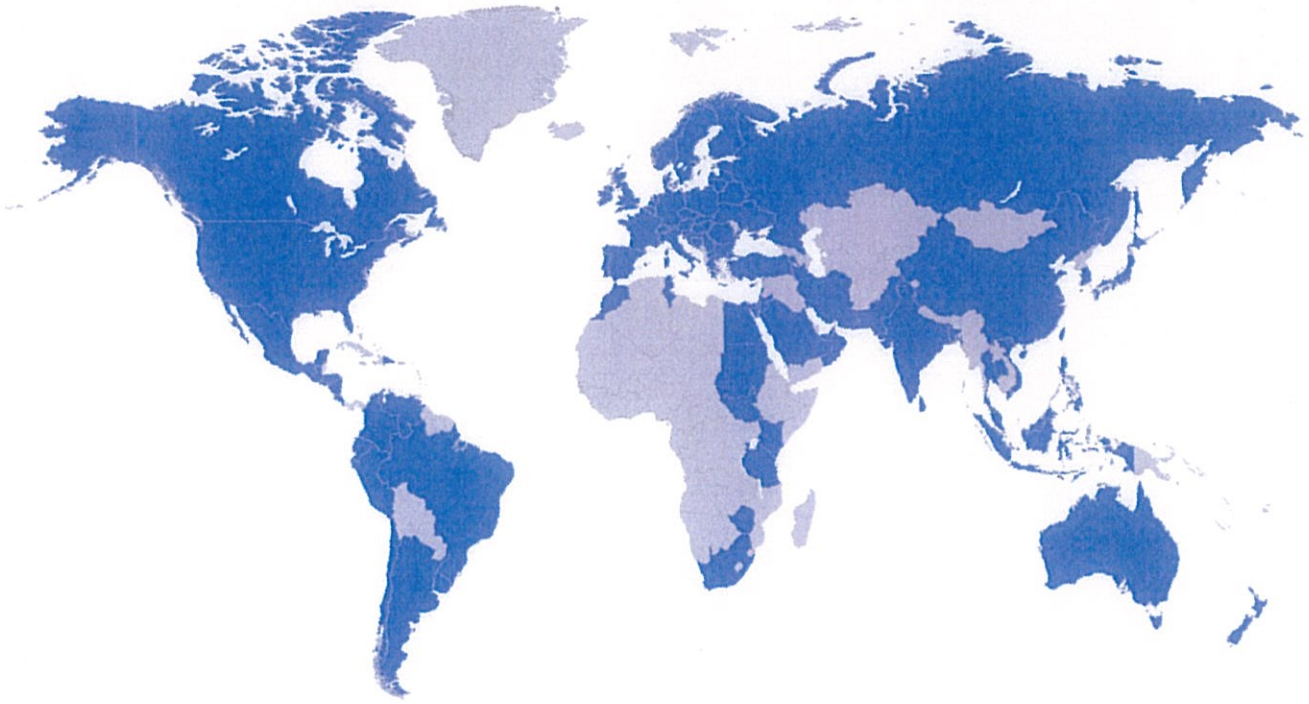
LMD POWDER

Uddeholm AM Corrax can also be used in laser metal deposition machines and is for that purpose available in the size fraction 50-150µm.
For further information please contact your local Uddeholm office.

POWDER INVESTIGATIONS

Uddeholm AM Corrax is a very robust powder with consistent quality and properties that can be re-used several times without powder degradation.

At Uddeholm we have a fully equipped powder laboratory to fully secure the quality of the powder so if you need help in qualifying your used powder to insure quality please contact your local Uddeholm office.



NETWORK OF EXCELLENCE

Uddeholm is present on every continent. This ensures you high-quality Swedish tool steel and local support wherever you are. We secure our position as the world's leading supplier of tooling materials.

Uddeholm is the world's leading supplier of tooling materials. This is a position we have reached by improving our customers' everyday business. Long tradition combined with research and product development equips Uddeholm to solve any tooling problem that may arise. It is a challenging process, but the goal is clear – to be your number one partner and tool steel provider.

Our presence on every continent guarantees you the same high quality wherever you are. We secure our position as the world's leading supplier of tooling materials. We act worldwide. For us it is all a matter of trust – in long-term partnerships as well as in developing new products.

For more information, please visit www.uddeholm.com

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